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**NAVAL UNDERWATER SYSTEMS CENTER
NEWPORT R I**

**NORLANT 72 PHASE 2 OPERATION PLAN. (U)
JUN 72**

GDS NUSC-TD-4373

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ABSTRACT

This document describes the scientific aspects of the joint U. S. -Canadian propagation-loss, signal-to-noise, and ocean-chemistry experiments that comprise Phase 3 of NORLANT 72. Experiment descriptions, data processing and reporting plans, levels of effort, and principal personnel are delineated for the studies to be conducted August-September 1972 in the Labrador Basin and Davis Strait.

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LIST OF ABBREVIATIONS

AXBT	Aircraft expendable bathythermograph
CDA	Cross-dipole array
CFAV	Canadian Forces Auxiliary Vessel
COMEX	Commencement of exercise/event
CONGRATS	Continuous-gradient ray-tracing system
CTD/SV	Conductivity-temperature-depth/sound-velocity (probe)
CW	Continuous wave
DREA	Defense Research Establishment Atlantic (Canadian)
FINEX	End of exercise/event
FNMC	Fleet Numerical Weather Central
GMT	Greenwich mean time
IOMEDEX	Ionian Mediterranean Exercise
LDGO	Lamont-Doherty Geophysical Observatory
LRAPP	Long-Range Acoustic Propagation Project
MABS	Moored acoustic buoy system
NAVOCEANO	Navy Oceanographic Office
NFEC	Naval Facilities Engineering Command
NRL	Naval Research Laboratory
NUSC	Naval Underwater Systems Center
NUSC/NL	New London Laboratory, Naval Underwater Systems Center
ONR	Office of Naval Research
PDR	Precision depth recorder
RF	Radio frequency
R/V	Research vessel
S/N	Signal-to-noise ratio
SOA	Speed of advance
SSOB	Senior scientist on board

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LIST OF ABBREVIATIONS (Cont'd)

STD	Salinity, temperature, depth (profile)
SUS	Signal, underwater sound
SVP	Sound-velocity profile
TABS	Telemetry acoustic buoy system
USB	Upper sideband
USNS	U. S. Naval Ship
USOP	Undersea Surveillance Oceanographic Project
VLA	Vertical line array
VLAM	Vertical-line-array measuring (system)
XBT	Expendable bathythermograph
Z	Time zone Z (Greenwich mean time)

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NORLANT 72 PHASE 3 SCIENTIFIC PLAN

I. GENERAL

(U) This scientific plan includes a description of each experiment to be conducted during Phase 3 of NORLANT 72 and a data processing and reporting plan. Levels of effort and the principal investigator for each experiment are also delineated.

(1) Propagation-loss and signal-to-noise experiments will be conducted jointly by Canadian and U. S. personnel. The Canadian Defense Research Establishment Atlantic (DREA) will provide CFAV QUEST as one receiving platform and the Naval Underwater Systems Center (NUSC) will provide USNS SANDS (T-AGOR-6) as a second platform; Canadian Argus long-range patrol aircraft will deploy SUS charges along tracks intersecting the two vessels. DREA and NUSC are separately responsible for analyzing and reporting data obtained, and the exchange of Canadian-U. S. data will be arranged through CNO (Op-981).

(U) The ocean-chemistry measurements will be conducted by NUSC with the assistance of Naval Facilities Engineering Command (NFEC) Code FPO-1 personnel; the data obtained will be analyzed and plotted at sea, and a final report will be prepared in New London.

II. SCIENTIFIC ORGANIZATION

(U) The organization for the Phase 3 NORLANT 72 exercise is as follows:

a. Commands

ONR (Code 102-OS) — U. S. Program Sponsor

NFEC (Code FPO-1) — Environmental Modeling Planning

DREA — Canadian Program Sponsor

CNO (Op-981) — Data-Exchange Arrangements

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b. Scientific Staff

R. L. Martin, NUSC -- U. S. Chief Scientist

Dr. H. M. Merklinger, DREA -- Canadian Chief Scientist

K. W. Lackie, USOP -- Operations, Logistics, and Oceanographic-Data
Coordinator

J. M. Syck, NUSC -- Assistant Oceanographic-Data Coordinator

c. Senior Scientists On Board

R. F. LaPlante, NUSC -- SANDS

Dr. H. M. Merklinger, DREA -- QUEST

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III. EVENT 1 — SHOT PROPAGATION-LOSS AND SIGNAL-TO-NOISE MEASUREMENTS

OBJECTIVES

(C) The objectives are to

a. Obtain propagation-loss and signal-to-noise measurements between three sets of two stations each in the area between the Labrador Basin and Baffin Bay. One station set covers the deep-water basin of the Labrador Sea, a second set covers the area from the deep-water basin to the shallow southern approaches of Davis Strait, and the third set straddles Davis Strait.

b. Obtain azimuthal directivity of ambient noise by means of a cross-dipole array (CDA) at stations between the Labrador Basin and Baffin Bay.

APPROACH

(C) SANDS will maintain positions at the southern end of each track (stations S2, S3, and S5 shown in figure 1) with a telemetering acoustic buoy system (TABS) array of two hydrophones deployed at 800 and 3000 ft and telemetering acoustic data to the ship via an RF link; QUEST will simultaneously maintain positions at the northern end of each track (stations Q2, Q3, and Q5) with a 60-ft vertical line array (VLA) deployed at 100 ft depth and a single hydrophone at 400 ft hardwired to the vessel. Canadian Argus aircraft will drop Mk 15 SUSs at 6 nmi intervals; the SUSs will be set to detonate at 60 ft on the first leg of each event and at 380 ft on the second (reciprocal track) leg; at ranges between 0 and 20 nmi from each ship shots will be detonated every 2 nmi. The 25 to 1000 Hz data received will be analyzed in 1/3-octave bands for propagation loss as a function of depth. Track lengths will be 960 nmi for the deep-water event, 640 nmi for the approaches to Davis Strait, and 460 nmi for the event through Davis Strait. Supporting bathymetric data and expendable-bathymograph (XBT) data will be obtained for each track.

(C) QUEST will deploy the CDA at stations Q2 through Q5 before or after each propagation events in order to obtain azimuthal noise-directionality measurements.

CONFIDENTIAL**DATA PROCESSING PLAN**

(C) All shots of each event at each station will be processed through analog 1/3-octave frequency bands centered at 25, 50, 100, 200, 400, and 1000 Hz, digitized, squared and integrated, noise corrected, and reduced to propagation-loss and S/N values. A total of 144 propagation-loss versus range curves and 36 S/N versus depth curves will be generated and analyzed. Propagation modeling for each parameter set (track, source depth, receiver depth, and frequency) will be requested from the Fleet Numerical Weather Central (FNWC) through the LRAPP office. The directional ambient-noise data will be similarly analyzed to yield one curve per station of relative level versus azimuth.

DATA REPORTING PLAN

(U) A preliminary report of 1/3-octave analysis of propagation loss, noise, and S/N will be completed for the SANDS data by 1 November 1972. This report will contain 72 propagation-loss curves, the 36 S/N curves, track bathymetric data, and supporting environmental observations. A similar report for data collected on QUEST will be available 1 January 1973.

(U) The final NUSC report will be completed by February 1973 and will contain the FNWC modeling results for QUEST and SANDS data.

**DATA PROCESSING, ANALYSIS, AND REPORTING
EFFORT (SANDS DATA)**

(U)	1/3-octave processing of all shots	3 man-months
	Preliminary data analysis and reporting	1 man-month
	Final report and analysis	2 man-months

PRINCIPAL INVESTIGATORS

(U) The principal investigators for this event are R. F. LaPlante, NUSC, and Dr. H. M. Merklinger, DREA.

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IV. EVENT 2 — OCEAN-CHEMISTRY MEASUREMENTS

OBJECTIVE

(U) The objective is to measure the vertical profiles of temperature, conductivity, salinity, sound velocity, dissolved oxygen, and pH at site M-2 in the Labrador Sea. The data will be considered representative of the summer conditions and utilized for the design of structures that could be placed in the area. The data will permit calculation of corrosion potentials of materials as a function of depth.

DESCRIPTION OF EXPERIMENT

(U) Measurements will be conducted at three stations within 50 nmi of site M-2 (shown in figure 1). At each station a Plessey conductivity-temperature-depth/sound-velocity (CTD/SV) system will be used to obtain a continuous profile of conductivity, temperature, and sound velocity as functions of depth down to the maximum capability of the instrument (about 3000 m). A 12-bottle rosette sampler will be used in conjunction with the CTD/SV to obtain water samples for shipboard determination of dissolved oxygen and pH. The sample interval will be such that 12 equally spaced samples will be taken. Samples from the maximum depth of the CTD/SV to the bottom (approximately 4000 m) will be obtained by using five Nansen bottles at equally spaced intervals to slightly overlap the rosette-sampler profile. Oxygen values will be determined by the Winkler method.

DATA ANALYSIS PLAN

(U) The output of the CTD/SV will be recorded by two methods — on a graphic recorder that provides a real-time profile and performance monitoring during lowering, and on a tape recorder that will store digital information for later analysis ashore. The digital data will be printed and plotted with the computer at NUSC/NL. Salinity will be calculated from CTD/SV information and plotted. Dissolved oxygen and pH information will be hand plotted as the data are obtained. Nansen-cast data will be used to calculate sound velocity, and this information will supplement the CTD/SV data to yield a composite profile from the surface to the bottom.

DATA REPORTING PLAN

(U) A final report consisting of a short narrative, computer data outputs, and the profiles will be submitted within one month of completion of the cruise.

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DATA-PROCESSING, ANALYSIS, AND REPORTING EFFORT

- (U) Data-acquisition and analysis at sea 3 man-weeks
- Data-analysis and reporting ashore 2 man-weeks

PRINCIPAL INVESTIGATOR

- (U) The principal investigator for this event is J. M. Syck, NUSC.

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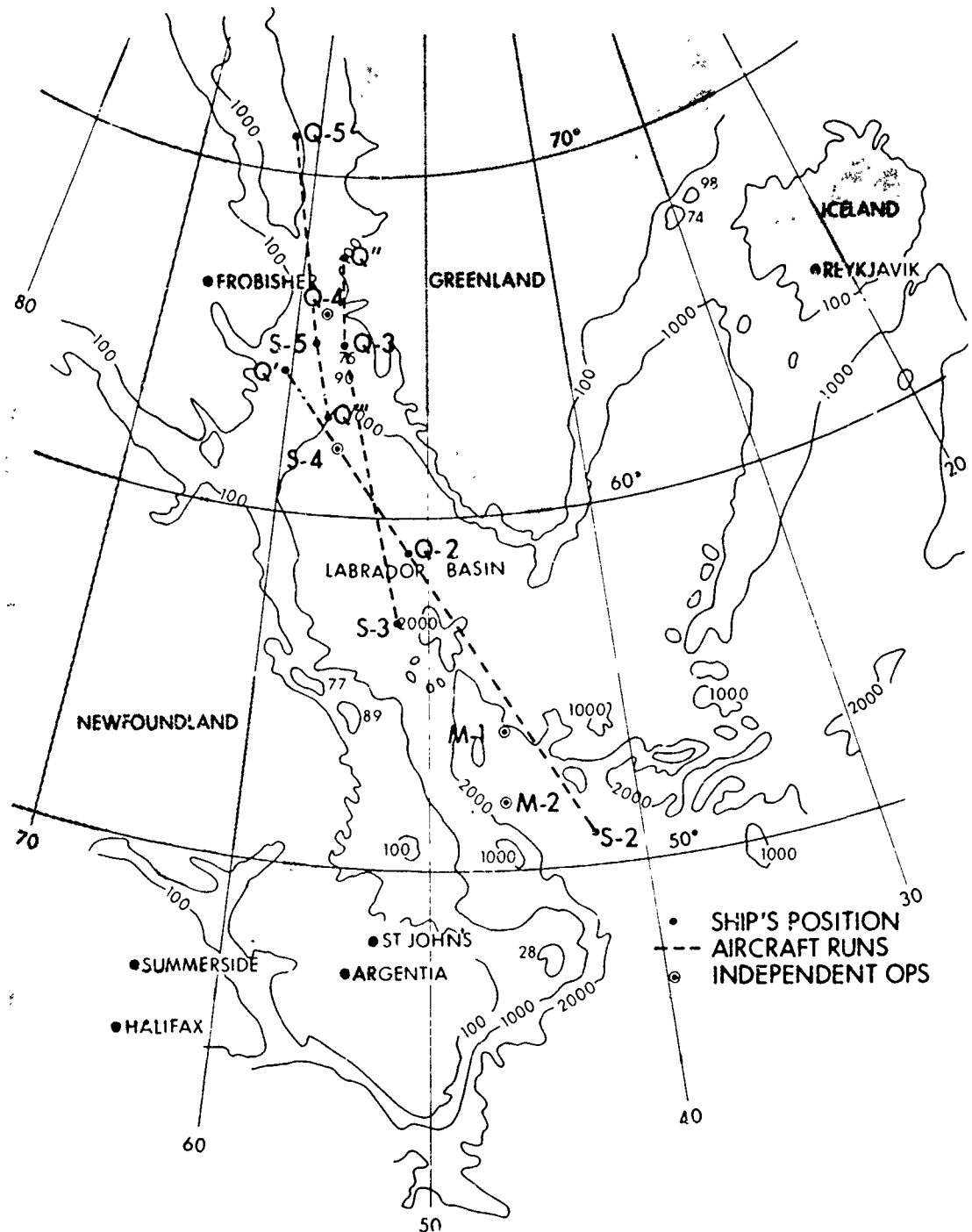


Figure 1. (C) Site, Station, and Track Locations (U)

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Annex A

ENVIRONMENTAL DATA PLAN

(U) All environmental data will be forwarded to the Oceanographic Data Coordinator by 30 September 1972, by hand or by mailing to U. S. Naval Oceanographic Office (Code 7005), Washington, D. C. 20390. Data such as AXBT, XBT, bathymetry, sound-velocimeter, and STD records will be machine digitized, processed, verified, and coded on punched cards or magnetic tape for final plotting. These data can also be made available in a format suitable for input to propagation-loss prediction modeling programs. It is anticipated that this effort will be completed by 31 December 1972.

(U) The Oceanographic Data Coordinator will review, as promptly as possible after the exercise, the ship and aircraft environmental data obtained for completeness and adequacy for project objectives.

(U) Plots of environmental data made during or after the experiment will have the following formats:

XBT, AXBT, and other data shallower than 1000 m depth will be plotted to the following scales: sound velocity on the abscissa to a scale of 20 m/sec per in.; depth on the ordinate to a scale (left hand) of 100 m per in. for a total scale length of 10 in. (1000 m); the right-hand ordinate scale will be labeled to show each 200 ft.

Composite displays showing each plot of sound velocity versus depth (for a given location) at a position along the abscissa that indicates the time at which it was taken will have a time scale of 10 hr per in. along the abscissa.

Preliminary bathymetric-profile diagrams are required to have a horizontal scale of 20 nmi per in. reading from west to east and a vertical scale of either 500 fathoms per in. or 1000 m per in.

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IR 71-2	Fenner, D. F., et al.	SOUND VELOCITY AND BOTTOM CHARACTERISTICS FOR LRAPP ATLANTIC AREAS I, II, AND III (U)	Naval Oceanographic Office	710601	ADC008372; ND	U
T-71-NJ-4508-C	Larsen, H. L., et al.	LRAPP DATA COLLECTION (U)	Tracor, Inc.	710831	AD0517012; ND	U
Unavailable	Anderson, C. G., et al.	ADAPTIVE BEAMFORMING ANALYSIS FOR DIRECTIONALITY USING DATA FROM A VERTICAL ARRAY IN THE MEDITERRANEAN	Naval Undersea Research and Development Center	710901	AD0517696	U
MC PLAN 06	Unavailable	IOMEDEX LRAPP OPERATION ORDER (U)	Maury Center for Ocean Science	710924	ND	U
NRLFR7322	Lawson, W. M.	POSITION-DETERMINING SYSTEM FOR SEA-SPIDER HYDROPHONE ARRAYS	Naval Research Laboratory	711230	ND	U
N00014-71-C-0088	Unavailable	CONTINUATION OF LRAPP FINAL REPORT (U)	Bell Laboratories	720201	AD0520426; NS; ND	U
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